UPCOM
Technologies, Inc.

User Guide

Ku Band
Solid State Amplifiers – SSPA
Redundant Configuration

Outdoor Band Solid State Amplifier System – Redundant Configuration User Guide

This section provides general information for the UPCOM TECHNOLOGIES line of Outdoor Solid State Amplifers – SSPAs with **Built-In Redundancy Configuration Option**. The Outdoor SSPA has been designed and manufactured to be extremely robust and reliable. It is well suited for harsh outdoor environments.

Description

Please refer to Appendix A for the appropriate product data sheet and specifications.
The Outdoor SSPA Redundancy Ready is a one-piece integrated amplifier system. It includes the AC / DC Power Supply, microwave Booster Amplifier Module, microcontroller based monitor and control circuitry, and an efficient thermal management system.
The reduced size and weight of this system allow it to be used in a wide variety of installations; many of which historically precluded the use of solid state units. This system is ideal for mounting on the boom of small antennas or anywhere that size and weight are a major concern.

Features include:

- Compact size
- Light weight
- Auto-Sensing Power Supply
- Output Power Detection
- Internal 1:1 Redundant Capability – Built in Controller
- Serial (RS-232 / RS-485) Control Circuitry
- Windows Monitor & Control Software
- Optional gain control (on selected configurations)

Equipment Supplied

The following equipment is supplied with each unit:

- The Outdoor SSPA Assembly
- Prime Power Mating Connector
- M & C Mating Connector
- “Y” Cable between SSPAs and WG Switch
- CD with UPCOM TECHNOLOGIES Monitor & Control Software (where applicable)
- Low Power Driver BUC (where applicable)
- WR75 Waveguide adapter BUC-SSPA (where applicable)

General Information

Safety Considerations

Potential safety hazards exist unless proper precautions are observed when working with this unit. To ensure safe operation, the user must follow the information, cautions, and warnings provided in this manual as well as the warning labels placed on the unit itself.

High Voltage Hazards

Only qualified service personnel should service the internal electronic circuitry of the Outdoor SSPA. High DC voltages (400 VDC) are present in the power supply section of the amplifier. Care must be taken when working with devices that operate at this high voltage levels. It is recommended to never work on the unit or supply prime AC power to the unit while the cover is removed.

RF Transmission Hazards

RF transmissions at high power levels may cause eyesight damage and skin burns. Prolonged exposure to high levels of RF energy has been linked to a variety of health issues. Please use the following precautions with high levels of RF power.

- Always terminate the RF input and output connector prior to applying prime AC input power.
- Never look directly into the RF output waveguide.
- Maintain a suitable distance from the source of the transmission such that the power density is below recommended guidelines in ANSI/IEEE C95.1. The power density specified in ANSI/IEEE C95.1-1992 is 10 mW/cm². These requirements adhere to OSHA Standard 1910.97.
- When a safe distance is not practical, RF shielding should be used to achieve the recommended power density levels.

Inspection

When the unit is received, an initial inspection should be completed. First ensure that the shipping container is not damaged. If it is, have a representative from the shipping company present when the container is opened. Perform a visual inspection of the Outdoor Amplifier to make sure that all items on the packing list are enclosed. If any damage has occurred or if items are missing, contact: UPCOM TECHNOLOGIES Inc.

Return of Equipment

When returning items back to UPCOM TECHNOLOGIES for replacement or repair, please prepare the following information:

- A written description of the problem encountered.
- The part number and serial number of the unit in question.

Once this information is ready, contact UPCOM TECHNOLOGIES for a Return Material Authorization (RMA) number and shipping instructions.

Ports and Interfaces

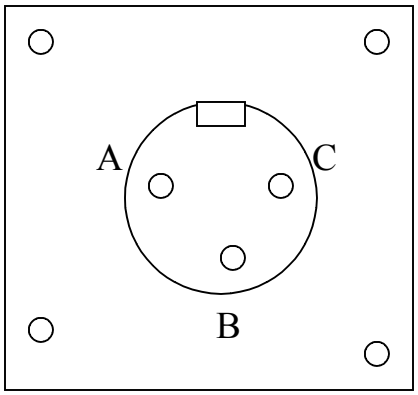
Prime Power Connection

The Prime Power Connector is the point where the unit receives input power. A connector **3100A 14S-7P** is used.

The AC input can operate over a range of 90 - 270 VAC, at 47 - 63 Hz. This connector is a 3 (three) pin circular connector and the mating connector is supplied with the unit

AC Input Connector Pin out:

Pin A	Line	90-260 VAC, 47-63Hz
Pin B	GND	
Pin C	Neutral	



Units with higher output power levels (> 50 W for Ku Band and > 100 W for C Band) should be powered only from a 180 - 270 VAC source. This will keep AC line currents to a safe operating level and minimizes cable losses.
In some cases, the unit may only be specified to operate at higher input voltage levels – please check the labels or accompanying Test Record for this information.

When wiring up the mating connector, carefully follow the pin descriptions noted in the accompanying Test Record. Incorrect connections can seriously damage the unit. It is highly advisable that the installer checks all the pins at the AC connectors for resistance to the chassis ground to make sure that the live and ground pins are correctly identified .
Please contact the factory if there are any questions regarding these input connections.

RF Input

The RF Input is a type WR75 Flange Grooved . Make sure that a properly sized gasket is used at the flange, with silicone paste. The input frequency is in the KU Band. **Nominal RF input levels are approximately + 20 dBm** depending on the output power level and the system gain of the unit.

The maximum input level should be limited to +33 dBm to avoid damaging the unit.

RF Output

The RF Output is brought out through waveguide in the Outdoor SSPAs. The Ku Band SSPAs have a WR-75 Grooved Flange while the C Band SSPAs have CPR style grooved flange (CPR-137G). An isolator is provided at the output flange with a termination capable of handling full reflected output power.

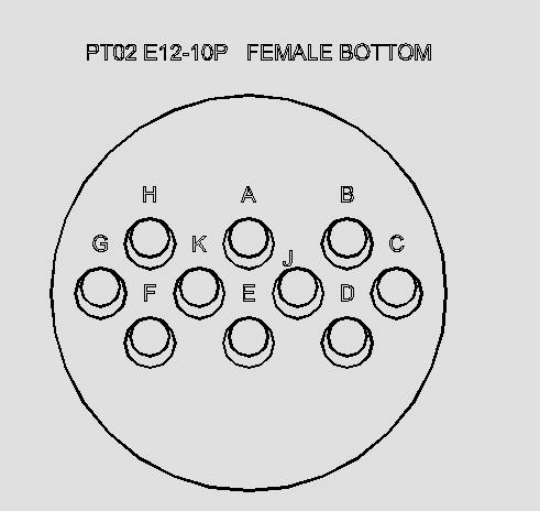
Caution should be observed here to make sure that the antenna or a suitable termination (dummy load) is connected to this port before operating the SSPA The SSPA is protected against reflection but dangerous levels of microwave energy can be present at this port.

<u>Never look directly into the RF output waveguide.</u>

M & C Connector

The Monitor and Control (M & C) connector is the primary interface point for controlling the SSPA and monitoring fault conditions. A 10 pin PT02 E12-10P Connector is used at the unit.

A Redundant configured unit may be operated in stand-alone mode, and behaves in a similar way to a normal Microcontroller equipped unit. If this is done, it is important to cover the Redundancy Port to protect it from the external environment, since there are live voltages present on this interface. Never connect anything except for the supplied cables to this interface port.



Pin Out for M&C Connector

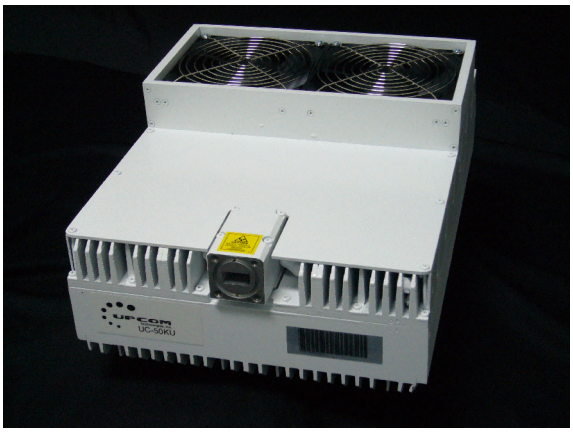
RS 485		**RS 232**	
A	Rx+	J	Rx
B	Rx-	K	Tx
C	Tx+	G	GND

D Tx-

Airflow

The air intake and exhaust are both located on the bottom side of the SSPA. The intake is brought through one or two fans (two fans on 50 watts units KU Band and higher and one fan on lower power units) while the exhaust is along the rows of heat-sink fins.
A minimum clearance of 12 inches (305 mm) should be maintained between the air intake of the Outdoor SSPA and exhaust during operation. This will ensure that there is no forced re-circulation of airflow from exhaust to intake.

Some lower output power units are not equipped with a fan, but the same clearance stated above must be kept around the unit for proper operation.



Monitors and Controls

Monitor signals and Control lines are present on the M & C Connector when this option is installed. Typically, single threaded units are **NOT** equipped with micro-controller by default. With a Microcontroller equipped system, all Monitors and Controls can also be accessed remotely by RS-232 / RS-485.to a Windows based PC; and other Alarms become available as well. Units equipped with a Redundancy option have a Microcontroller M & C installed by default.
Redundancy Controller is a built in module to the units . The redundancy ready units have a connector " SWITCH" which is connected to the waveguide switch via a "Y" cable supplied with the units.

The full M & C Connector pinout is listed here for convenience. However, always check the Test Bench Record supplied with the unit to view which interfaces have been installed on your unit, or to see if it has had any custom modifications.

Connector Name	**Type**	**Pin #**	**Signal**	**Parameter**
"RF IN"	WR-75	N/A	RF Input BUC OUT	33 dBm, max
"RF OUT"	WR-75	N/A	RF Output	47.0 dBm max
"AC POWER IN"	97-3100A-14S-7P 3 pin male	A	Line (AC)	110/220VAC 90-260V
		B	Ground	
		C	Neutral (AC)	
"M&C Interface"	PT02E12-10P-027 10 pin male	A	Rx+ In	RS-485
		B	Rx- In	
		C	Tx+ Out	
		D	Tx- Out	
		E	Detector	Optional
		F	Alarm Out	Low when alarm
		G	GND	
		H	Mute In	Muted when Low
		J	Rx In	RS-232
		K	Tx Out	
Redundancy Interface	PT02E12-10P-027 10 pin male	A		
		B		
		C		
		D		
		E		
		F		
		G		
		H		
		J		
		K		

RS232 COM port setting: 9600 bps, 8 bit, 1 stop bit

Temperature Monitor
The temperature of the unit baseplate is monitored by a voltage analogous to temperature. The output is 3.0 V at 27 ºC with a slope of 10 mV / ºC.

RF Output Power Monitor
The output power of the unit is monitored by a voltage analogous to the output power level. The voltage is restricted to in between 0 V to 5 V. This detected voltage is useful over a 20 dB range of output power.

Ground (GND)
This pin is connected to the chassis, which also represents the main Ground of the unit.

PLEASE MAKE SURE THAT THE UNIT AND CABLES ARE PROPERLY GROUNDED TO AVOID DAMAGES TO THE EQUIPMENT AND RISK TO PERSONEL !!!

RS-232 / RS-485
Available with optional Microcontroller equipped systems. This serial link is normally used to communicate with a remote PC running UPCOM TECHNOLOGIES Monitor and Control Software. This enables a simple way to view / control the Monitors and Controls listed above, and also enables the functions listed below.

Normally, either RS-232 or RS-485 is available at any one time (both interfaces cannot be used simultaneously). Communication links using RS-232 are typically good up to 30 ft. (9 m) in length. Installations exceeding this length should use the RS-485, which will allow serial control up to 4000 ft. (1200 m).

Monitor and Control Software
UPCOM TECHNOLOGIES Monitor and Control Software is provided on CD for units equipped with an onboard Microcontroller system. A Windows based PC uses this software to remotely monitor and control the SSPA through its serial port.

Various Monitors and Alarms are displayed along the left hand side of the interface. If a problem has been detected, it will be displayed in red, and the SSPA will be placed into a muted state.

Installation Instructions
System Requirements:

- PC running Windows 98, Me, 2000, or XP (NT 4.0 with Service Pack 6a)
- Display resolution of 800 x 600 or greater
- Free serial port (RS-232 or RS-485)

Compatibility under **Windows Vista** has not been tested.

Status Display (Optional)

This indicator shows the general status of the Outdoor SSPA – if everything is good, or if an error condition has occurred, or if the unit has been manually disabled by mute control. Also, the operating status of a Master/Slave redundant pair is reflected.

Booster Temperature Display (Optional)

Using the UPCOM TECHNOLOGIES Monitor and Control Software, a thermometer display with a numeric readout of the baseplate temperature of the unit in degrees Celsius is shown. The baseplate temperature typically experiences a 20 to 30 degree rise above ambient on the highest power Outdoor SSPAs and 15 to 20 degree rise on lower power units. This display corresponds with the Temperature Monitor outlined in the analog M&C section above.

Output Power Display (Optional)

A numeric readout of the output power level is displayed in units of dBm. The indicator is calibrated at the factory using the middle frequency of the SSPA, and has approximately a 20 dB dynamic range. When this range is exceeded, the readout shows “Low” or “High” depending on which particular limit has been reached.

Overheated Alarm (Optional)

This alarm indicates when the unit’s baseplate rises above about 85 ºC, which is an overheated condition. The unit will automatically enter into a muted state. This function has approximately a 20 ºC hysteresis window which will allow the SSPA to re-enable itself when the temperature is reduced by 20 ºC at the baseplate.

PS Voltages Monitor (Optional)

The output voltage levels of the Power Supply are monitored and this alarm indicates when any of them fall below a preset level. Three voltages are monitored: +12 V feeding the Booster Amplifier and –5 V from the bias assemblies attached to the Booster Amplifier. The unit will enter a muted state when this alarm is active.

Manual Control Enable/Disable and Mute Input (Optional)

A manual mute control can be accessed from the Enable/Disable button of the software. For systems set up for 1:1 Redundant operation, this control is also used for manually selecting the Active unit in a redundant pair.

Mate Status (Optional)

In redundant configurations, the Mate Status indicates the mute condition of its mate. That is, the Master display shows the Slave condition, and the Slave display shows the Master condition.

Attenuator Control (Optional)

System conversion gain can be changed here provided an attenuator module has been installed. The range of control is from 0 dB (no attenuation applied) to 20 dB (20 dB of gain reduction) in 0.5 dB steps. The value may be stepped up or down, or entered directly with the keyboard by highlighting the entry field. Note that this control is dependent on an installed hardware option. If it is not installed, this control will not have any effect.

Temperature Compensation

Tighter temperature compensation response is also possible with the attenuator module installed. There is no user control here, and the unit must have the requisite hardware option installed, and be calibrated at the factory for this function to be active.

Communication Status (Optional)

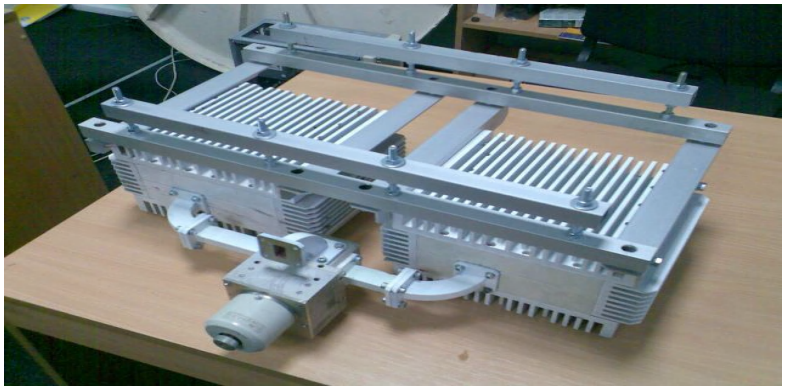
The communication status between the software and the SSPA is reflected here. If there is a problem here, double-check all serial port connections and ensure the correct Com port is selected (the software uses the Select Port menu item).

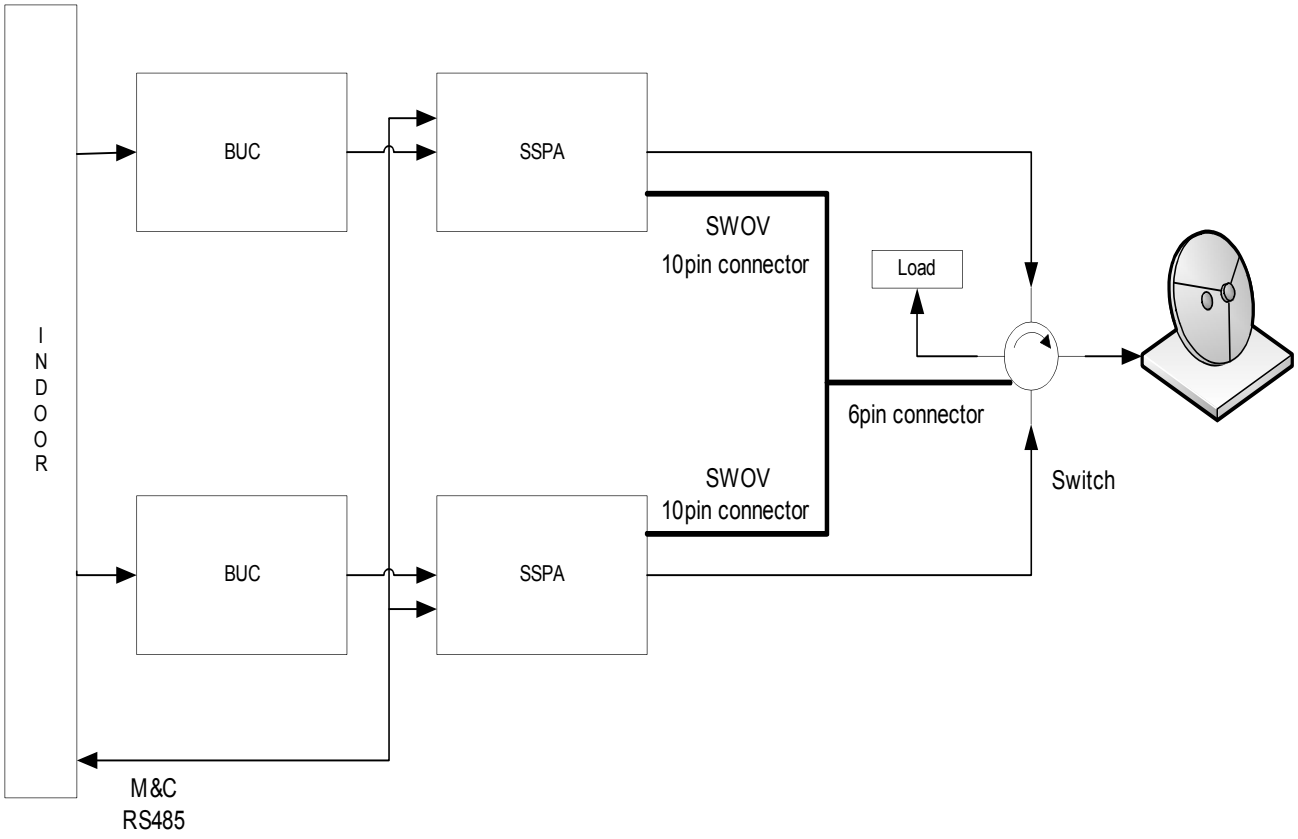
Menu Items (Optional)

Under the File menu item, there is a set of calibration routines exposed to the user. These are intended for factory use only. No support will be provided if any of these settings are adjusted.

Under the Select Port menu item, your appropriate Com port is selected for serial communication to the SSPA.

Redundancy Interconnection Diagram





Quick Start Guide

- **Check the connectivity of the AC Pins and also at the AC Cable to make sure that Line or Neutral pins are NOT connected to the ground**
- Connect the low power KU Band output from a low power BUC or indoor upconverter to the labeled port. Nominal input levels are approximately +20 dBm depending on the output power level of the unit.
- Connect the rigid waveguides to the SSPA's RF outputs and to the waveguide switch as indicated in the Redundancy Diagram
- Connect to the "Y" Cable supplied with the units to the "Switch " Ports at the units and to the control port of the waveguide switch.
- The SSPA's output is taken from the waveguide port (RF Out). Caution should be observed here to make sure that the antenna or a suitable termination is connected to this port before operating the SSPA.
- Ensure there is proper clearance around the unit.
- **Connect the chassis ground (GND) to a proper ground connection**
- Connect AC Input power to the connector. The unit will be enabled almost immediately, provided it is not forced into a mute state.
- Connect the M & C interface to an available COM port on your computer and/or to your analog based monitoring and control equipment.
- Run the UPCOM TECHNOLOGIES Monitor and Control Program.
- **Recommendation: if possible install the SSPA with the fans facing down in order to avoid accumulation of debris inside the fans that may block the fans.**

General Maintenance

With proper care and maintenance, your SSPA will provide many years of reliable service. Please follow these maintenance guidelines so that your equipment will provide you with the maximum amount of trouble-free service.

Basic Cleanliness

The exterior chassis of the SSPA acts as a large heatsink that must dissipate at least a few hundred Watts. Excessive dirt, dust, debris, and sand accumulated on the chassis surface will impede its ability to dissipate heat, and will result in higher internal temperatures, potentially shortening the SSPA lifespan.

Periodically inspect the chassis for excessive dirt, and remove as necessary. A brush combined with compressed air is the safest way to clean the unit. Also, inspect the fan assembly for any dirt or debris that also might impede airflow.

Internal Fuse

The internal power supply is protected by a fuse to prevent excessive input current consumption. Contact the factory if you suspect the internal fuse has tripped, and instructions will be sent on how it can be replaced.

Fan Replacement

Normally the fan on the unit operates continuously when input power is connected to the unit. If the fan stops turning, and the SSPA still provides an output signal when it is cool, it is time to replace the fan. Immediately remove power to the unit the prevent damage by overheating.

Contact the factory to order the correct replacement fan for your particular model.

The fan is encased in a shroud to direct airflow to the chassis heatsink fins. First remove the shroud from the main chassis using the screws at each side of the chassis. The fan and shroud assembly will be connected by wires to the main chassis. Disconnect the wire connection by pulling apart the inline (wire to wire) connector.

Next, remove the screws holding the fan to the shroud and fan grille. Remove the fan, and install the replacement fan in reverse order as described above.

Theory of Operation

AC / DC Converter

The prime AC input power is delivered to a converter module that produces 300 VDC. This module is an auto-sensing front end that has proven reliability and allows the amplifier system to operate over a wide variety of input power conditions encountered around the world.

DC / DC Converter

The DC/DC converter module is a switched mode power supply that converts the 300 VDC to 12 VDC. This 12 VDC is the primary high current, DC voltage source that operates the booster amplifier module.
A secondary module converts the 300 VDC to 24 VDC.

Units with input AC power use the above AC / DC and DC / DC topology.

Cooling System

The Outdoor SSPA's cooling system represents a landmark in microwave telecommunication amplifiers. It is a unique system of heat sinks that have been computer optimized to provide extremely efficient cooling of all of the system's functional blocks. This high efficiency cooling system is primarily responsible for the small overall package size and reduced weight of the unit.
The Cooling System is based on a forced convection technique in which both system fans provide the air intake while the exhaust is brought out around the outer perimeter of the fans. The fan is up to 300 CFM rated and operate into approximately 0.3 in. H_20 back pressure. It is also weather protected for reliability under a variety of conditions.

Amplifier

This module uses GaAs MESFET technology to boost the signal level to its final output power level. A bias assembly connects the +12 V power supply with the FETs, and provides proper bias voltages (including the negative voltage for the FET gates), and voltage sequencing at turn on and turn off. The gain for this section is in the neighborhood of 25 dB.

Microcontroller (Optional)

This section is responsible for serial communications and for processing of the Monitors and Controls. Various alarms are monitored, such as overheating, along with select DC voltages. The microcontroller disables the SSPA when any of these status indicators show a problem. In addition, it is possible for the microcontroller to report output power levels in dBm and control system conversion gain (when appropriate hardware is installed).

In Redundant configured units, the Microcontroller is also responsible for system switching behavior.

Attenuator Module

This is an electrically controlled variable attenuator – an optional component that generally receives control signals from the Microcontroller. It is responsible for both gain control functions and supplemental gain versus temperature compensation.

Appendix A

Operating Frequency Range	13.75 - 14.5 GHz
Output Power 1dB Comp	47 dBm
Input Power @ P1dB output	20 dBm nominal
Input Power range without damage	0 - 33 dBm
Input Return Loss	> -16 dB
Gain	25 dB min
Gain flatness	± 2.0 max
I/O VSWR	≤-15 dB
Gain flatness 40MHz	±0.3 dB
Gain Variation Over Temperature	± 3 dB max
Spurious @ P1dB	-55dBc max
IMD (With 2 carriers @6dB backoff 1dB Comp)	-27dBc max
Power supply	AC 90-260V ±20%, 50/60Hz
Operating Temperature	-30 °C to 55 °C
Relative Humidity	up to 98%
Weight (50 watts KU)	14 kg
Dimensions (50 watts KU)	256x182x377mm
Phase Noise	< -30 dBc/Hz at 10 Hz
	< -60 dBc/Hz at 100 Hz
	< -70 dBc/Hz at 1 kHz
	< -80 dBc/Hz at 10 kHz
	< -90 dBc/Hz > 100 kHz

Appendix B